“Phytochemical analysis and antimicrobial activity of weeds against seed borne pathogens of Soybean (Glycine max (L.) Merril)”

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Phytochemical analysis and antimicrobial activity of weeds against seed borne pathogens of Soybean (*Glycine max* (L.) Merril)

Introduction

Weeds are unwanted and undesirable plants which interfere with the utilization of land and water resources. This green vegetation is also flourished in aquatic systems, forestry, industrial sites, roadside, railway lines, landscapes water tanks and waterways. They have occupied hectares of fertile as well as non- fertile land. They compete with crops for space, water and minerals. Weeds are unwanted plants, but all unwanted plants may not be weeds (Gupta,2005).

Generally, weeds have been neglected and their use for medicinal purpose and their antimicrobial activity has not been considered on a large scale. For the progress of human beings, the plant recourses play an important role they fulfil many needs viz; food, fuel, fiber and medicine. In Indian ancient literature observed that each and every plant on this planet are useful in medicine, industry and allelopathy (Sastry and Kavatheker,1990).

The different phytochemicals like Alkaloids, Cellulose, Carbohydrates, Flavonoides, Glycosides, Phenols, Quinons Saponins, Tannins, Terpenoids, Triterpenoids, Steroids and many others screen out in the plants are key reservoirs of many new essential drugs. Phytochemical analysis is the primary way to the discovery of new useful drugs. Plants are the greatest reservoirs or recourses of drugs of traditional systems of medicine, phytochemical intermediates and chemical entities for synthetic drugs (Hammer *et al.,*1999). Phytochemicals are beneficial to boost up immunolatory responses and also provide immunity against many diseases.

Soybean (*Glycine max* (L.) Merril) is an important commercial crop known as the "GOLDEN BEAN," is a species of legume originated from East Asia. Soybean is a member of Leguminosae family. In Maharashtra, soybean is cultivated on a space of 3.8 M ha with making of 3.07 m ton with second position in India (Jaybhay *et al.,* 2018).

Soybean is oil and protein rich crop and utilized by humans and animals and also used for industrial purposes (Singh, 2010; Prance and

Nesbitt, 2012; Shurtleff and Aoyagi, 2013). Soybean is superior legume in terms of health benefits as compared to others. It has lower fat content with beneficial Omega-3 fatty acid and no cholesterol amount. It is a good source of fibre, calcium and vitamin B. Due to the amount and quality of protein content; soybean is widely used in human nutrition as soy flour (full fat and defatted) and soy protein (concentrate and isolates).

Seeds are used in the preparation of certain confectionary products. The seeds are consumed locally after splitting as dal (Beryl and Molly, 1986). The oil obtained from soybean is semi-dry in nature and is used in cooking. It is also employed for packing sardines, tuna and other kinds of fish. It also finds use in industry for the manufacture of soaps, glycerin, grease, lubricants, waterproofing material, oilcloth, putty, paints, varnishes, candles, printing ink, resins, insecticides, disinfectant, leather dressing and linoleum. It is also used as an emulsifier and in the cosmetics, pharmaceutical, plastic industry and in detergents. Soybean meal is suitable for livestock and poultry feed and used in making plastics (Sen, 2000).

Soybean is recently found to be an important crop for industrial application as biofuel, core oil, anti-corrosion agent due to its less or no nitrogen content in oil. It is also used in production of cosmetics and antibiotics (Ngalomu et al. 2012). Soybean plant helps in crop diversification and in growth of other crops by increasing the amount of soil nitrogen during crop rotation (Singh, 2010). In addition to the previously described uses, soybean is also used in aquaculture as diets for the fishes and other aquatic species.

In soybean cultivation the major constraints are seed borne pathogens. Seed germination in soybean has considerably reduced due to presence of seedborne diseases. Seed borne pathogens have been involved in seed rots during germination and seedling mortality leading to poor crop stand reduction in plant growth and productivity of crops (Akranuchat *et al.*, 2007). Infected seeds also play major role in the establishment of economically important plant diseases in the field resulting in heavy reduction of crop yields. It has been reported that more than 100 plant

pathogens affect soybean, several economically important diseases have been reported. Among them *Phakopsora pachyrhizi*, *Cercospora kikuchii*, *Colletotrichum*, *Fusarium*, and *Macrophomina* are some of the very important. It also includes *Alternaria, Cladosporium* and *Penicillium* which are secondary invaders on the injured pods. Thus, the present work aims to study the important seedborne diseases of soybean and their control by using weed extracts.

Today there is a global search for alternatives to chemical fungicides, as part of this process various efforts have been carried out to use and apply natural products for disease control and crop production. In recent years much attention has been given to non -chemical systems to protect plants against soil and seed borne pathogens. Many plants and plant products have been known for their medicinal and antifungal properties since ancient times (Kuntal Das *et al.*, 2010). Scientists are on their way to achieve some plant derived compounds to control diseases. Natural plant products are biodegradable, exhibit structural diversity and complexity and rarely contain halogenated atoms. These can act directly as fungicide or may provide structure lead for fungicide discovery (Duke *et al.*, 2000 and Hina Ashraf *et al.*, 2007).

The weed diversity and its utilization particularly in the welfare of crop plants is least reported. During botanical excursions to different parts of this phytogeographic region every year, it is observed fact that weeds produce a huge biomass. This fact promoted to work on the present research topic. Studies on the biocontrol of plant pathogens especially using weed biomass of the crop fields is important need.

Considering these facts, the present investigation is planned to study weed diversity in study area, screening of weeds for phytochemicals and to study the efficacy of common, dominant and easily available weeds in the crop fields against seed borne pathogens of soybean (Glycine max (L). Merrill). in a cost-effective and eco-friendly manner.

Review of Literature

Weed has been viewed in many ways depending upon perspectives of peoples from different spheres some of the definitions are presented where as follows.

Brenchley, (1920)-"A plant that grows so luxuriantly or plentifully that it chokes out all other plants that possess more valuable nutritive properties and they are harmful to man, animals and crops."

There are over 30,000 species of weeds around the world of which about 18,000 cause serious losses (Pandya, 2009). The weed diversity provides direct economic benefits in the form of food, fibres, fragrance, cosmetics, biopesticides and biofertilizers. Weed diversity is a great source of medicines. The biochemicals present in vast majority of the weeds are the great reservoirs of new and potential drugs. The weed resources are the major sources of antimicrobial agents. They can be used for monitoring the environmental changes. They are the key resources for new genes and biotechnologically valuable compounds. In India the studies on weed diversity cover very low area. The workers have extensively studied the weed flora, but detailed studies on diversity and utilization of weeds are meager. In the present review of literature, attempts have been made to discuss the work of earlier workers on these aspects.

Williams and Groves, (1980) discovered that *Parthinium hysterophorus* had a great potential for wide distribution because of its capability to germinate and grow over a wide range of temperature.

Studies on preliminary phytochemical analysis and antimicrobial activity of some weeds collected from Marathwada region were done by Dhole *et. al.,* (2011). Phytochemical screening and analysis of selected medicinal plants in Gujrat was done by Khalid *et al.,* (2018) and found the presence of Flavonoids, Tannin, Phenolic compounds and Alkaloids as important bioactive components of plants. Chavan e*t al.,* (2013) has

performed phytochemical analysis of some weeds and screened some weeds against seed borne pathogens.

Plant diseases have become a permanent threat since human societies started to rely on agriculture as on a major food provider. Back history, outbreaks of plant diseases resulted in human catastrophes. Fungal pathogens are important not only because they reduce crop yield, but also due to certain compounds they produce during proliferation on / in plants. These compounds are called mycotoxins which are highly poisonous and can adversely affect human and animal health (Pier, 1980 and Pitt, 2000).

Large number of diseases attacks Soybean in India. The majorities are caused by fungi and several of them are yield reducers in certain regions and seasons (Mayee, 1995). Soybean crop suffers from diseases to a much larger extent than other crops. From its early stage of development to maturity it is attacked by various pathogens. In India it is attacked by over 100 pathogens including viruses.

Seed as a biological entity and a basic agricultural input, is the end product of plant growth by which plant life is regenerated**.** Plant disease causing pathogens are mostly seed borne and seed transmitted. Seed-borne pathogens cause diseases of seed, seedling, and adult plants at various growth stages (Sangvikar, 2012).

In soybean cultivation the major constraints are seed borne pathogens. Seed germination in soybean has considerably reduced due to presence of seedborne diseases. Seed borne pathogens have been involved in seed rots during germination and seedling mortality leading to poor crop stand reduction in plant growth and productivity of crops (Akranuchat *et al.*, 2007). According to FAO, there are about 12 % annual losses in crop productivity due to plant diseases alone. These losses are supposed to increase with change in agricultural practices. India which is tropical country with warm and humid climate provides ideal conditions for development and spread of crop diseases cultivated under good management systems (Rakh, 2010, Deshmukh, 2014). Different species of *Alternaria, Aspergillus, Ceratobasidium, Cercospora, Cochliobolus, Curvularia,*

Dreschslera, Fusarium, Gaeumannomyces, Microdochium, Penicillium, Pyricularia, Pythium, Rhizoctonia, Rhizopus, Sclerophthora, Trichoderma and *Tricoconella* are most common associates of seeds all over the world, causing pre and post-infections and considerable quality losses *viz.* seed abortion, seed rot, seed necrosis, reduction or elimination of germination capacity, seedling damage and their nutritive value have been reported (Miller, 1995; Janardhana *et al.,* 1998; Kavitha *et al.,* 2005).

In India weeds are very common and dominant in crop fields. They produce huge waste biomass. The huge waste biomass may be utilized for seed health and also as the source of fungicide. Considering this fact attempts were made to determine biomass of weeds by different workers have been given in the present review of literature. Many plants and plant products have been reported to possess fungicidal properties (Grange M. and Ahmed S., 1988; Grayer and Harborne, 1994).

Elisabeth *et al.,* (2008) studied the importance of seed borne fungi of sorghum and pearl millet in Burkina Faso and their control using plant extracts. Haikal, (2008) showed that the fungi reduced percentage of seed germination and seedling development in soybean.

Bodke *et al.,* (2005) screened root extracts of thirty-one plants against seed mycoflora, seed germination and seedling emergence of Bajra. They reported that root extracts of all the least plants were found to be inhibitory in more or less degree for the incidence of seed mycoflora while with few exceptions they were found to be stimulatory for the seed germination and seedling emergence of Bajra. Satish *et al.,* (2007) studied antifungal activity of some plant extracts against the commonly occurring important seed borne phytopathogenic fungi and storage fungi

Dalvi, (2010) studied the effect of extracts of rare and endangered plants on seed mycoflora and seed health of jowar, wheat, Groundnut and soybean. Deshmukh, (2014) studied utilization of weed biomass for the management of soil and seed borne diseases of Groundnut.

Pal and Kumar, (2013) investigated the antifungal activity of some weed extracts viz., *Achyranthes aspera, Parthenium hysterophorus, Cannabis*

sativa, Calotropis gigantean, Chenopodium album, Canada thistle, Phalaris minor, Cynoden dactylon, Argemone maxicana, Ageratum conyzoides, and *Lantana camera* against seed-borne phytopathogenic fungi causing wilt disease. Out of 11 weeds tested, the extracts of *Cannabis sativa, Ageratum conyzoides* and *Argemone maxicana*, were found most effective against phytopathogenic fungi, *Fusarium oxysporum*. The methanol extracts of *Cannabis sativa, Argemone maxicana*, and acetone extract of *Ageratum conyzoides*, can be used for the development of novel broad spectrum herbal fungicidal formulations after *in vivo* and field trial.

Objectives of the study:

1. To study weed diversity in study region. (Collection, Description, Identification and preparation of herbarium)
2. To evaluate the presence of different preliminary phytochemicals from the collected weed species. (Extraction, Analysis and Identification)
3. To study seed-borne fungi of soybean. (Identification and detection of seed borne fungi)
4. To isolate, characterize and identify various seed borne pathogens associated with seeds of soybean (*Glycine max* (L). Merrill).
5. To check pathogenicity of seed borne fungi.
6. To study effect of selected weed extracts on seed borne phytopathogens.

Materials and Methods

1. **Collection and identification of weeds**

The weed diversity of Groundnut fields in Parbhani district will be studied as per the methods described by Rehman *et al.,* (2007). The collection of weeds of Marathwada region from different areas by successive visiting and their identification with different floras Flora of Marathwada by Naik V.N. (1998).

The morphology of weeds will be studied as per the method described by Alexiades (1996) and Siddique *et al*,. (2005) and Dalvi (2010).

2. **Phytochemical analysis**

From the collected weeds will be separated and dried in shade, finely made powder using Mixer grinder. The leaf powders of the test weeds will be stored in airtight bottles. for the further studies.

Bioassay

Leaf powder of different test weeds were used for preliminary screening of phytochemicals such as Alkaloids, Saponins, Tannins, Steroids and Flavonoids. The phytochemicals were determined by standard protocols as described by Jigna *et al.*, (2007).

3. **Studies on Seed-Borne Fungi of Soybean**

I. Detection of seed mycoflora of soybean

For the detection of seed mycoflora, methods described by Paul Neergaard, (1977) will be followed. Seed mycoflora will be detected by moist blotter plate and agar plate method.

II. Isolation and Identification of seed mycoflora of soybean

For isolation, the procedure published by ISTA (2003) will be followed. The identification will be confirmed with the help of latest manuals, Subramanian, (1971), Neergaard and Mathur, (1980), Jha, (1993) and Mukadam, (1997).

III. Pathogenicity of seed borne fungi of soybean

Pathogenicity will be tested by seed germination method as described by ISTA (2003).

4. Studies on antifungal activity of extracts of weed biomass against seed borne pathogens of soybean

I) Preparation of weed extracts

For the preparation of weed extracts the methods described by Kuntal Das, (2010) will be followed.

II) Efficacy of weed extracts against seed borne pathogens of soybean

The efficacy of weed extracts will be calculated as per cent inhibition of mycelial growth over control which will be calculated by using the formula as given by (Verma and Kharwar, 2006).

III) Studies on utilization of weed biomass for seed health of soybean crop

Utilization of weed biomass for seed health of Groundnut crop will be studied by method as described by Kuntal Das, (2010).

5. Statistical analysis

For Statistical analysis the method described by Panse and Sukhatme, (1978) will be used.

Importance of study/Society application

International status

In nature, there are certain plants which grow profusely in adverse conditions and are considered as undesirable, injurious, unsightly plants as they interfere with our valuable and cultivated crops. There are known as weeds and are defined as the plants which are not purposely grown or the plant which are self-grown at places where they create unwanted problems. The term weed is also applied to any plant that grows or reproduces aggressively, or is invasive outside its native habitat. These plants are also unwanted as they compete with the desired plants for natural resources like light, space, water, minerals, etc., hence generates stress on cultivated plants. Some weeds are poisonous due to presence of a vast number of secondary metabolites like high alkaloids, tannins, oxalates, glycosides and other substances which are harmful to animals (Lee, 2007). These

metabolites protect plants against various contagious agents like bacteria, fungi, viruses, etc.

Many weeds especially agricultural weeds are known for their nutritional value. Looking at the vast nutritional and medicinal properties these weeds possess, efforts should be made to explore the biological potential of these unwanted pants so that they can be utilized for the betterment of mankind. These self-grown unutilized plants can therefore act as potential tool for the discovery of new phyto -drugs. Keeping in view the availability of beneficial phytochemicals in weeds and the shift towards natural products in pharmaceuticals due to various reasons, the present study was planned to analyse phytochemicals present in different weeds in study area.

National status

In ancient Indian literature it is observed that every plant on this planet is useful in industry, medicine and allelopathy. The diversity of weeds in crop fields may prove a huge resource for the coming new biotechnologies. The phytochemicals like flavonoids, coumarins, amino acids, cyanogenic compounds, glycosides, saponins, steroids, tannins and many others present in weeds are the great reservoirs of many new and potential drugs. Thus, weeds are the key resources for new genes and biotechnologically valuable compounds.

Many weeds are known to have antimicrobial properties also. Therefore, the detail study of weed diversity of crop fields and its utilization is an urgent need of human beings.

Society application

'India is primarily an agricultural country.' India is primarily an agricultural country because more than 60% of India's population depends upon agricultural and allied activities for their source of livelihood. Indian economy depends greatly on the number of wild plant species including weeds. The weed diversity in the crop fields would be a great source of medicines. By identifying the potential national and international markets of common medicinal weeds, farmers can earn additional income. The weed

diversity may prove a boon to farmers. It may be a frontier. Therefore, the detail study of weed diversity of crop fields and its utilization is an urgent need of human beings. This fact promoted to work on the present topic.

Proposed work Plan/ Formulation and Structure of Study: Year-wise Plan of work and targets to be achieved

Sr No.	Year	Activity	Tentative Duration
1	First Year	1.Completion of coursework 2. Survey and Review of literature 3. Collection, Description, Identification of weeds and preparation of herbarium	12 months
2	Second Year	1. Extraction of plant materials using different solvents 2. Phytochemical analysis of selected weeds 3. Study of seed borne pathogens of soybean	12 months
3	Third Year	1 Antifungal activity of selected weeds 2 Data analysis and thesis writing for submission to the university 3. Paper publications & Paper presentations 4. Writing the thesis	12 months

References

Akranuchat P, Noimanee, P. Krittigamas, N. Horsten D.V. and Vearasilp. S. (2007). Control of seed borne fungi by radio frequency heat treatment as alternative seed treatment in barely (Hordeum vulgare). Conference on International Agricultural Research for Development. October 9-11. University of Gottingen, Germany.

Alexiades, M. N. (1996). Collecting ethnobotanical data: an introduction to basic concepts and techniques, In *Selected Guidelines for Ethnobotanical Research: A Field Manual* edt. M. N. Alexiades, *The New York Botanical Garden Publications,* New York: 53.

Beryl, B.S. and Molly C.O. (1986). Economic botany of plants in our world. McGraw Hill Book Co. New York. pp. 197-199.

Bodke, S. S., A. S. Kandhare, D. U. Gawai and S. S. Wadje (2005). Screening of root extracts of different plants against seed mycoflora, seed germination and seedling emergence of *Pennisetum typhoides* Burm. *J. Bot. Soc. Uni. Sagar*, Vol. 40: 43-50.

Brenchley, W. E. (1920). Weeds. *Newyork Longmanas Green and Co.*

Chavan Y.R., Thite S.V, Aparadh V. T., Kore B. A. (2013). Phytochemical analysis of some weeds. The Global Journal of Pharmaceutical Research Vol. 2(1), pp.xxxx.

Dalvi, S. M. (2010). Studies on Diversity, Utilization and Conservation of Rare Flowering Plants in Nanded District. *Ph.D. thesis, S.R.T. Marathwada University, Nanded* (M.S.) India.

Deshmukh R.S. (2014). Utilization of plant biomass for the management of soil and seed borne diseases of groundnut (*Arachis hypogaea* L.). *Ph.D. Thesis, Swami Ramanand Teerth Marathwada University, Nanded.*

Dhole, J. A, Dhole, N. A, Lone, K. D and Bodke S. S. (2011). Preliminary Phytochemical Analysis and Antimicrobial Activity of Some Weeds collected from Marathwada Region. *Journal of Research in Biology* 1: 19-23.

Duke, S. O., Dayan F. R., Romaine, J. C., and A. M. Rimando (2000). Natural products as sources of herbicides: status and future trends. *Weed Res.*, 40: 99-111.

Elisabeth, Z. P., Paco S., Vibeke L., Philippe S., Irenee S. and Adama N. (2008). Importance of seed-borne fungi of sorghum and pearl millet in Burkina Faso and their control using plant extracts. *Pak. J. Biol. Sci.*, 11: 321-331

Grainge, M. and Ahmed, S. (1988). Hand book of Plants with Pest-Control Properties. John Wiley & Sons, Hoboken, 470 p.

Grayer, R.J. and Harborne, J.B. (1994) A Survey of Antifungal Compounds from Higher Plants, 1982-1993. *Phytochemistry*, 37, 19-42.

Gupta, O. P.; 2005; Weed management Principles and Practices; Agrobios (India) Jodhpur-342002.

Haikal, N. Z., (2008). Effect of filtrates of pathogenic fungi of soybean on seed germination and seedling parameters, *Journal of Applied Sciences Research*, 4(1): 48-52.

Hammer KA, Carson CF and Riley TV. J Appl Microbiol 1999; 86(6): 985.

Hina Ashraf and Arshad Javaid (2007). Evaluation of antifungal activity of Meliaceae family against *Macrophomina phaseolina*. *Mycopath* 5(2): 81-84.

ISTA, (2003). International Rules for Seed Testing. In: Draper (Ed.), Rules 2003. Switzerland*: International Seed Testing Association*, Zurich, pp. 1–520.

Janardhana, G. R., Raveesha, K. A. and Shetty, H. S. (1999). Mycotoxin contamination of maize grains grown in Karnataka (India). *Food Chemical Toxicology* 37: 863 – 868.

Jaybhay S.A., S.P. Taware, Philips Varghese and V.R. Nikam (2018). Soybean cultivation by farmers of Maharashtra: Identification and analysis of the problems. *Legume Research*, 41 (3) : 474-479.

Jha, D. K. (1993). A text book on seed pathology. Vikas Publishing House pvt. Ltd. New Delhi, 132pp. (reprint 1995).

Jigna Parekh, Sumitra V, Chanda. (2007). *Turk J Biol* , (31) 53-58.

Kavitha, R., S. Umesha and H.S. Shetty (2005). Dose dependent impact of dominant seed-borne fungi on seed germination and seedling vigour of cotton seeds. *Seed Res.* 33(2): 187–194.

Khalid Sheraz, Adil Shahzad, Neelam Basharat, Muhammad Abubakar and Pervaz Anwar (2018). Phytochemical Screening and Analysis of Selected Medicinal Plants in Gujrat. *J Phytochemistry Biochem*, Vol 2(1).

Kuntal Das, R. K. Tiwari and D. K. Shrivastava (2010). Fungitoxic properties of rhizome extracts of some medicinal plants. *Life Science Bulletin*, Vol. 7(1): 01-05.

Kuntal Das, R. K. Tiwari and D. K. Shrivastava (2010). Fungitoxic properties of rhizome extracts of some medicinal plants. *Life Science Bulletin*, Vol. 7(1): 01-05.

Mayee, C. D. (1995). Current status and future approaches for management of groundnut disease in India. *Indian Phytopath*. 48:389-401.

Miller, J. D. (1995). Fungi and mycotoxins in grain implications for stored product research. *J. Stored Product Res*. 31(1): 1–16.

Mukadam D. S. (1997). The illustrated kingdom of fungi (some selected genera). Published by Akshar Ganga prakashan, Aurangabad, India.

Naik, V. N. (1998). *Flora of Marathwada*, Vol. I-II. Amrut Prakashan, Aurangabad, M.S. (India).

Neergaard, P. and Mathur S. B. (1980). University teaching of seed pathology, published by Prasaranga, University of Mysore, India.

Ngalamu, T., S. Meseka and M. Ashraf. (2012). Performance of soybean (*Glycine max* (L) Merrill) genotypes under different planting dates in Sennar State of the Sudan. Journal of Applied Biosciences. 49: 3363-3370.

Pal, G. K. and Kumar, B. (2013). Antifungal activity of some common weed extracts against wilt causing fungi, *Fusarium oxysporum, Current Discovery*, 2(1): 62-67.

Pandya, P. R. (2009). A study of the weed flora of some cultivated fields of Bharuch district. *Ph. D. Thesis*, Saurashtra University, pp-1-22.

Panse, V. G. and P. V. Sukhatme (1978). *Statistical methods for agriculture workers,* ICAR, New Delhi.

Paul Neergaard (1977). Seed Pathology, Vol. I, John Villy and Sons, New York.

Pier, A. C, Richard, J. L. and Cysewski, S. J. (1980). Implications of mycotoxins in animal disease. *J Am Vet Med Assoc*. 176:71–724.

Pitt, J. I. (2000). Toxigenic fungi: which are important? *Med. Mycol*. 38(Suppl. 1):17-22.

Prance, S. G. and Nesbitt, M. (2012). The Cultural History of Plants. Routledge. New York, London. pp. 452.

Rakh, R. R. (2010). Investigation on biological control of Major Groundnut (*Arachis hypogaea* Linn.) Diseases. *Ph.D. Thesis*, *Swami Ramanand Teerth Marathwada University, Nanded*.

Rehman, A. H., Anisuzzaman M., Ferdous A., Naderuzzaman A. T. M. and Rafiul I. A. K. M. (2007). A floristic study in the graveyards of Rajshahi city. *Research Journal of Agriculture and Biological Sciences*, 3(6): 670-675.

Sangvikar, Roopa V. and Wadje, S.S. (2012). *In-vivo* testing of plant extracts against seed borne pathogens. *I. Res. J. Biological Sci.* Vol. 1(6), 1-4.

Sastry C.S.T. and Kavatheker K.Y. (1990). Plants for reclaimation of wastelands. New Delhi, India:

Satish, S., D. C. Mohana, M. P. Raghavendra and K. A. Raveesha (2007). Antifungal activity of some plant extracts against important seed borne pathogens of *Aspergillus sp. Journal of Agricultural Technology,* 3(1): 109-119.

Sen, B. (2000). Biological control. A success story. *Indian Phytopath*. 53:243-349.

Shurtleff, W., and Aoyagi, A. (2013). History of Soy Flour, Grits and Flakes (510 CE to 2013): Extensively Annotated Bibliography and Sourcebook. Soyinfo Center. http://www.soyinfocenter.com/pdf/171/Flou.pdf.

Siddique, N. A., Bari, M. A., Pervin, M. M., Nahar, N., Banu, L. A., Paul, K. K., Kabir, M. H., Huda, A. K. M. N., Mollah, M. U. and Ferdaus, K. M. (2005). Screening of endangered medicinal plant species by Questionnaire survey in Barind tract in Bangladesh. *Pakistan Journal of Biological Sciences* 8(12):1783-1793.

Singh G. (2010). The Soybean Botany, Production and Uses. CABI. pp. 512.

Subramanian, C. V. (1971). Hypomycetes: An account of Indian species except *Cercospora*. *ICAR, New Delhi*. 930pp.

Verma, V. C. and R. N. Kharwar (2006). Efficacy of neem leaf extract against it's own fungal endophyte *Curvularia lunata*. *Journal of Agricultural Technology*, 2: 329-335.

Williams, D. J. and Grovers H. R. (1980). The influence of temperature and photoperiod on growth and development of *Parthenium hysterophorus* L. *Weed Research*, 20(1): 47-52.

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